

Appl. No. 10/633,241
Reply to Final Office Action of October 20, 2005

REMARKS

Claims 1-21 are pending in the application, with claims 1, 13, and 18 being independent claims. Claims 1, 13, and 18 have been amended. No new matter is believed to have been added to the application.

I. Claim Rejections Under 35 U.S.C. § 103(a)

In the Office Action of October 20, 2005, the Examiner rejected claims 1-7, 9-10, and 18-21 as unpatentable under 35 U.S.C. § 103 over U.S. Patent No. 6,664,557, issued on December 16, 2003 to Amartur (hereinafter "Amartur"). In light of the above amendments, this rejection is respectfully traversed.

For a claim to be properly rejected for obviousness, the Examiner must show that the subject matter sought to be patented would have been obvious to one of ordinary skill in the art at the time the invention was made. Applicants respectfully submit that a *prima facie* case of obviousness has not been made out by the Examiner because every critical element appearing in the claims is not disclosed by the cited reference.

Claim 1 of the instant application is directed to a method for detecting an endpoint of a chemical mechanical planarization (CMP) process. The method comprises the steps of providing a light pulse on an area of a surface of a semiconductor wafer, receiving light reflected from the area and obtaining a measurement of the reflected light for the area. The location of the area from which the measurement is obtained is tracked and a reflectance spectra associated with the measurement and the location of the area are analyzed. The steps are repeated until an intermediate reflectance spectra is identified that has a sinusoidal shape when normalized. A parameter of the CMP process corresponding to the area is adjusted relative to another area of the semiconductor wafer based on an analysis of the reflectance spectra and the location associated therewith.

In contrast, Amartur does not disclose, teach or suggest the steps of obtaining a measurement of reflected light for an area of a surface of a wafer and tracking the location of the area from which the measurement was obtained. While the Examiner asserts that the method of Amartur "encompasses tracking since the light is not arbitrarily directed" and hence that tracking is inherent, Applicants note that, in Amartur, the platen 254 and the optical detector 260 are stationary and the pad 250 rotates about the platen.

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An optical beam from the detector is transmitted through a slot in the pad. There is no indication that the wafer carrier moves other than rotationally. Thus, nowhere does Amartur discuss or even suggest a method for tracking the location on the wafer where the optical beam hits. Further, there is no indication that the method in Amartur does anything more than takes arbitrary measurements of the wafer at a time and averages them together. Further, Amartur does not provide for adjusting a polishing parameter associated with a particular area on the wafer. Accordingly, there is no reason for Amartur to track the location of the measurements. "[W]hen an examiner relies on inherency, it is incumbent on the examiner to point to the 'page and line' of the prior art which justifies an inherency theory." Ex parte Schricker, 56 USPQ.2d 1723, 1725 (B.P.A.I. 2000) (unpublished); see also Ex parte Levy, 17 USPQ.2d 1461, 1464 (B.P.A.I. 1990) ("[T]he examiner must provide a basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic necessarily flows from the teachings of the applied prior art.") As the Examiner has not indicated by page and line the discussion in Amartur suggesting or otherwise indicating that the method of Amartur necessarily utilizes tracking of measurements, Applicants respectfully assert that Amartur fails to disclose or suggest this element.

In addition, Amartur does not disclose adjusting a parameter of the CMP process corresponding to the area measured relative to another area of the wafer based on an analysis of the reflectance spectra and the location associated therewith. Amartur is directed only to the detection of the endpoint of a CMP process. Amartur does not discuss or suggest modifying the CMP process, other than ending the process at a certain point. (See Amartur, Col. 9, line 49-53) Further, Amartur does not disclose or suggest ending the CMP process in one area relative to another area of the wafer.

Accordingly, since Amartur does not disclose, either explicitly or inherently, at least the above-noted features of claim 1, it does not render obvious independent claim 1, and claims 2-12 that depend therefrom, and reconsideration and withdrawal of the § 103(a) rejection is therefore solicited.

In the Office Action of October 20, 2005, the Examiner also rejected claims 18-21 as unpatentable over Amartur. In light of the above amendments, this rejection is respectfully traversed.

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Claim 18 of the instant application is directed to a method of wafer processing including end point detection for a chemical mechanical planarization process (CMP). The method comprises the steps of forming at least one trench in a dielectric layer of a semiconductor wafer, depositing a barrier material on a surface of the semiconductor wafer such that the barrier material forms a layer on a bottom and sidewalls of the trench and depositing copper on the surface of the semiconductor wafer such that the trench is filled with copper. A first CMP process is performed to remove a layer of copper on the surface of the semiconductor wafer such that the copper remains in the trench and a second CMP process is initiated to remove the layer of barrier material on the surface of the semiconductor wafer. Reflectance spectra data is taken on different areas of the surface of the semiconductor wafer using a broadband spectrum of light ranging from 300 nanometers to 800 nanometers in wavelength and the locations of the different areas from which the reflectance spectra data is taken is tracked. When the reflectance spectra data is modified by the dielectric layer underlying the barrier layer, it is identified to assess when the barrier metal has been thinned. A parameter of the second CMP process corresponding to a first area of the different areas of the semiconductor wafer is adjusted relative to a second area and the second CMP process is continued with an approximate thickness of the barrier layer that remains being known.

In contrast, Amartur does not disclose, teach or suggest a method of wafer processing comprising the step of taking reflectance spectra data on different areas of the surface of the semiconductor wafer using a broadband spectrum of light ranging from 300 nanometers to 800 nanometers in wavelength. In addition, as described above, Amartur does not disclose the step of tracking the location of the different areas from which the reflectance spectra data is taken. Amartur also does not disclose the step of identifying when the reflectance spectra data taken from the locations is modified by the dielectric layer underlying the barrier layer to assess when the barrier metal has been thinned at the locations.

Further, as described above, Amartur does not disclose adjusting a parameter of a CMP process corresponding to the area measured relative to another area of the wafer based on an analysis of the reflectance spectra and the location associated therewith. Amartur is directed only to the detection of the endpoint of a CMP process. Amartur

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does not discuss or suggest modifying the CMP process, other than ending the process at a certain point. (See Amartur, Col. 9, line 49-53) Further, Amartur does not disclose or suggest ending the CMP process in one area relative to another area of the wafer.

Accordingly, since Amartur does not disclose, either explicitly or inherently, at least the above-noted features of claim 18, it does not render obvious independent claim 18, and hence claims 19-21 that depend therefrom, and reconsideration and withdrawal of the § 103(a) rejection is therefore solicited.

In the Office Action, the Examiner also rejected claims 8, 11-17 as unpatentable over Amartur in view of U.S. Patent No. 6,340,602, issued on January 22, 2002 to Johnson et al. (hereinafter "Johnson"). In light of the above amendments, this rejection is respectfully traversed.

Claims 8, 11, and 12 of the instant application depend from claim 1. As described above, claim 1 of the instant application is directed to a method for detecting an endpoint of a chemical mechanical planarization (CMP) process. The method comprises the steps of providing a light pulse on an area of a surface of a semiconductor wafer, receiving light reflected from the area and obtaining a measurement of the reflected light. The location of the area from which the measurement is obtained is tracked and a reflectance spectra associated with the measurement and the location of the area are analyzed. The steps are repeated until an intermediate reflectance spectra is identified that has a sinusoidal shape when normalized. A parameter of the CMP process corresponding to the area is adjusted relative to another area of the wafer based on an analysis of the reflectance spectra and the location associated therewith.

As described above, Amartur does not disclose, teach or suggest, either explicitly or inherently, at least the above-noted features of claim 1. Further, Johnson does not disclose, teach or suggest the steps of obtaining a measurement of reflected light for an area of a surface of a wafer and tracking the location of the area from which the measurement was obtained. While Johnson describes measuring reflection properties of various zones of a wafer, Johnson teaches calculating a total reflection property from the reflection properties of the different zones. (Col. 9, lines 38-42). Johnson does not teach tracking the locations of the various zones or the locations of the measurements taken therefrom. In addition, Johnson does not disclose, teach or suggest analyzing a

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reflectance spectra associated with the measurement and the location of the area from which the measurement was obtained. Further, Johnson does not disclose adjusting a parameter of the CMP process corresponding to an area of the wafer relative to another wafer based on an analysis of the reflectance spectra and the location associated therewith.

Accordingly, since neither Amartur nor Johnson discloses, either explicitly or inherently, at least the above-noted features of claim 1, it does not render obvious claims 8, 11 and 12 that depend therefrom, and reconsideration and withdrawal of the § 103(a) rejection is therefore solicited.

In the Office Action, the Examiner also rejected claims 13-17 as unpatentable over Amartur in view of Johnson. In light of the above amendments, this rejection is respectfully traversed.

Independent claim 13 of the instant application is directed to a method for detecting an endpoint of a chemical mechanical planarization (CMP) process. The method comprises the step of taking reflectance spectra data periodically on different areas of a surface of a semiconductor wafer during the CMP process and tracking the location of each of the different areas from which the reflectance spectra is taken. A first reflectance spectra corresponding to a first layer of material on at least one of the different areas of the surface of the semiconductor wafer such that the first reflectance spectra comprises light reflected predominately from the first layer of material is identified. A second reflectance spectra corresponding to the first layer of material on the surface being thinned such that the second reflectance spectra is modified by a second layer of material underlying the first layer of material is identified. A third reflectance spectra corresponding to the first layer of material on the surface being substantially removed such that the third reflectance spectra comprises light reflected predominately from the second layer of material is identified. A parameter of the CMP process corresponding to the at least one of the different areas may be adjusted relative to another of the different areas based on an analysis of the reflectance spectra and the locations associated therewith.

In contrast, neither Amartur nor Johnson discloses a method of detecting an endpoint of a CMP process comprising the steps of tracking the location of each of the

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different areas from which reflectance spectra is taken and adjusting a parameter of the CMP process corresponding to one area of the wafer relative to another area based on an analysis of the reflectance spectra and the locations associated therewith. Accordingly, since neither Amartur nor Johnson discloses, either explicitly or inherently, at least the above-noted features of claim 13, it does not render obvious claim 13, or claims 14-17 that depend therefrom, and reconsideration and withdrawal of the § 103(a) rejection is therefore solicited.

II. Conclusion

In view of Applicants' amendments and remarks, it is respectfully submitted that the Examiner's rejections under 35 U.S.C. § 103(a) have been overcome. Accordingly, Applicants respectfully submit that the application, as amended, is now in condition for allowance, and such allowance is therefore earnestly requested. Should the Examiner have any questions or wish to further discuss this application, Applicants request that the Examiner contact the Applicants' attorneys at the below-listed number.


If for some reason Applicants have not requested a sufficient extension and/or have not paid a sufficient fee for this response and/or for the extension necessary to prevent abandonment on this application, please consider this as a request for an extension for the required time period and/or authorization to charge Deposit Account No. 50-2091 for any fee which may be due.

Respectfully submitted,

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